**[0076]** The use of parallel polled bimorph reeds in combination with bimorph clip **30** eliminates the prior art need for sixteen (16) wires and thirty-two (32) hand-solder joints per Braille cell assembly. The parallel polled bimorph reed design also results in an estimated fifty percent (50%) power reduction by reducing the operating voltage and the mechanical resistance presented by the prior art construction.

**[0077]** Note that each bimorph actuator is mechanically held at its fulcrum by metal contacts on the PCB. These contacts also provide an electrical connection for biasing the bimorph actuator. This novel structure is an improvement over the above-mentioned prior art structures that hold the bimorph in a mechanical frame formed of non-conductive plastic and which require the soldering of sixteen (16) wires and thirty-two (32) hand-soldered connections per cell. The new cell eliminates all wires and thus all of the thirty two (32) hand-soldered connections. Only the center conductor is soldered by hand in the novel design. This solder connection is completed in the constraints of alignment fixture to accurately control the position of the work end of the bimorph.

**[0078]** Bimorph clip **30** may be thought of as a split clip or an isolated clip because the contact on the top of the bimorph is electrically isolated from the contact on the bottom of the bimorph. In another embodiment of clip **30**, known as a common clip, net deemed currently suitable for use in a commercial embodiment of the invention, the top of the bimorph is mechanically and electrically connected to the bottom of the bimorph. Although functional, the effects of long-term aging of the ceramic in the bimorph are unacceptable. In this common clip, both halves of the bimorph work in concert with one another but untested piezo material properties, specifically the aging effect of reverse-biasing the ceramic material, require further investigation. Half the high voltage, or 100 volts, was applied to the center of the common clip. This center voltage, or bimorph virtual ground, enables the use of standard high voltage drive circuitry and a common clip. The common clip may become viable as advances are made in piezo-ceramic technology.

**[0079]** The serviceability of each novel bimorph is maintained and improved over other designs. If an individual Braille dot does not meet specification, that Braille cell is removed and the bad bimorph removed by ref lowing a single solder joint. Tie replacement bimorph is then inserted into the Braille cell PCB and aligned with the aid of a fixture. This avoids the problem in removing prior art bimorphs where individual bimorph removal is complicated by the attachment of two (2) wires to each bimorph.

**[0080]** FIG. **4**A depicts a Braille cell assembly **40** mounted on top wall **44** of a chassis/backplane not depicted in this figure and FIG. **4**B depicts a plurality of said Braille cell assemblies mounted on said top wall. Braille cell assembly **40** includes PCB **36** to which is soldered a plurality of novel bimorph clips **30** in vertically spaced relation to one another during standard SMT processing. A bimorph reed **20** is then inserted between biased arms **32**, **34** of each clip **30** using an alignment jig. Each center conductor **26** of each bimorph reed **20** is then soldered to PCB **36**. This process eliminates the need for sixteen (16) hand-soldered jumper wires. It also eliminates the prior art need for providing plating on bimorph reed **20** to enable said bimorph reed to accept solder.

**[0081]** A plurality of PCB-receiving sockets **42** is mounted on top wall **44** in spaced relation to one another as depicted. A large number of Braille cell assemblies **40** may therefore be mounted to said top wall as suggested by FIG. **4**B.

**[0082]** FIG. **5** discloses the pin connections of Braille device interface **50**. Interface **50** defines the required connections to drive the display. This embodiment enables left or right side connections and further enables independent scanning of key switches without changing latched display data.

**[0083]** FIGS. **6**A and **6**B are perspective views of opposite sides of Braille cell assembly **40**. The disclosure of these FIGS. **6**A and **6**B is essentially the same as the disclosure of FIGS. **4**A and **4**B but FIGS. **6**A and **6**B make it clearer that clips **30** and bimorph reeds **20** are mounted on both sides of PCB **36**. Note that there are four (4) bimorph reeds **20** mounted on each side of PCB **36** so that there are eight (8) bimorph reeds mounted on each PCB **36**. Accordingly, it should be understood that each PCB is dedicated to a Braille cell having eight (8) Braille pins and each bimorph reed is dedicated to a Braille pin of said Braille cell.

**[0084]** FIG. **7**A is a top perspective view of chassis/backplane **60** and FIG. **7**B is a bottom perspective view thereof. Chassis/backplane **60** includes top wall **44** (see FIGS. **4**A and **4**B) and bottom wall **46**. It also includes an angle wall **62** having a plurality of sets **64** of pinholes or bores **66** formed in a horizontal part **62*a*** thereof. Horizontal part **62*a*** of angle wall **62** abuts a leading edge of top wall **44** and is coplanar therewith. Each pinhole or bore **66** is adapted to slideably receive a pin, not depicted in FIGS. **7**A and **7**B. Note that there are eight (8) pinholes or bores **66** per set **64** of pinholes or bores.

**[0085]** Upstanding flat wall **68** abuts a trailing edge of top wall **44** and a trailing edge of bottom wall **46**. A plurality of slots **70** is formed in the lower edge of said flat wall **68**. Each slot engages a protuberance **36*a*** formed in the trailing end of its associated PCB. A corresponding plurality of slots **72** is formed in top wall **44** to accommodate the respective leading ends of the PCBs. Each set of slots **70** and **72** cooperate with one another to provide a mount for each PCB **36**.

**[0086]** FIG. **8**A depicts chassis/backplane **60** when a PCB **36** is mounted in each slot **70** and **72**. It also depicts a Braille pin **80** disposed in each pinhole or bore **66**. One (1) bimorph reed **20** is associated with each pin **80**, there being one PCB **36** having eight (8) bimorph reeds mounted thereto associated with each set **64** of eight (8) pinholes or bores **66** as aforesaid.

**[0087]** Pins **80** are provided in four differing lengths as indicated in FIG. **8**B. The pins may be manufactured individually, or they may be manufactured in connected-together groups of eight (8) that are separated from one another after assembly into the Braille cell, thereby improving manufacturability.

**[0088]** Each pin **80** has a solid or hollow construction and includes four (4) parts that share a common longitudinal axis of symmetry. Each of the four (4) parts may have a transverse cross-section of any predetermined geometrical configuration. A more detailed description of the pins is provided in U.S. patent application Ser. No. 10/710,808, filed Aug. 4, 2004 by the same inventors. That patent application is hereby incorporated by reference into this disclosure.

**[0089]** The novel cell cap of this invention is depicted in FIGS. **9**A and **9**B and is denoted as a whole by the reference numeral **90**. Twenty (20) sets **92** of pinholes **94** are depicted, each pinhole being adapted to slidingly receive tip **80*d*** of pin **80**. This configuration is referred to as a "double decade" and represents one (1) module. Unlike the aforementioned prior art Braille cells that require one individual cap per set of pinholes, cell cap **90** is a monolithic cap for all sets of pinholes, i.e., cell cap enables one cap to cap a plurality of Braille